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DESIGN OF MODEL 2.040 AND 2.041 QUADRALOOP ANTENNAS



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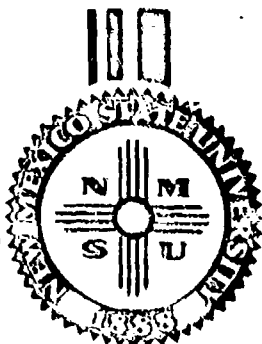
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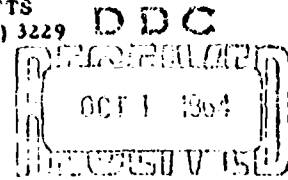
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Project 7043
Task 765901

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OFFICE OF AEROSPACE RESEARCH
UNITED STATES AIR FORCE
BEDFORD, MASSACHUSETTS
Under Contract No. AF 19(628) 3229



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PHYSICAL SCIENCE LABORATORY

NEW MEXICO STATE UNIVERSITY

University Park, New Mexico

September 1963

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DESIGN OF MODEL 2.040 AND 2.041 QUADRALOOP ANTENNAS

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ABSTRACT

The Models 2.040 and 2.041 Quadraloop Antennas are the result of a mounting problem associated with the Aerobee rocket telemetry extension. The Model 2.041 is the pressurized version of the un-pressurized Model 2.040. Electrical and mechanical characteristics are given in the form of graphs and figures.

TABLE OF CONTENTS

	Page
1.0 Introduction.....	1
2.0 Electrical Characteristics.....	1
2.1 Usable Frequency Range.....	1
2.2 Impedance and Bandwidth.....	1
2.3 RF Breakdown.....	1
2.4 Radiation Characteristics.....	9
3.0 Mechanical Characteristics.....	9
3.1 Construction.....	9
3.2 Mounting.....	9
4.0 Conclusions.....	9
5.0 Bibliography.....	12

LIST OF FIGURES

	Page
Fig. 1 Model 2.040 Quadraloop	2
Fig. 2 Model 2.041 Quadraloop	3
Fig. 3 Assembly of Model 2.040 Quadraloop (PSL Drawing No. 005066)	4
Fig. 4 Assembly of Model 2.041 Quadraloop (PSL Drawing No. 005067)	5
Fig. 5 Frequency Range vs Tie-Screw Size.....	6
Fig. 6 Impedance of Single Quadraloop.....	7
Fig. 7 Impedance of Paralleled Pair of Quadraloop.....	8
Fig. 8 Radiation Power Contour Plot	10
Fig. 9 Mounting Assembly of Model 2.040 and 2.041 Quadraloops (PSL Drawing No. 005066, Sheet 2 of 2)	11

1.0 INTRODUCTION

The Aerospace Instrumentation Laboratory of Air Force Cambridge Research Laboratories has requested the Physical Science Laboratory of New Mexico State University to adapt the basic quadraloop antenna to fit directly on the standard Aerobee rocket 10-inch telemetry extension. The present antenna used for this application is too long and must be shortened to facilitate mounting on the short extension.

2.0 ELECTRICAL CHARACTERISTICS

The quadraloop antenna design parameters have been given in previous reports.¹ This report will cover only the electrical characteristics and physical mounting for the Model 2.040 and 2.041 Quadraloop Antennas. The Model 2.040 is un-pressurized and the Model 2.041 is pressurized. Photos are seen in Figs. 1 and 2.

These antennas are of the standard type with a fixed capacitor added for endloading to obtain the desired frequency in the shortened antenna. Assembly drawings of the antennas are shown in Figs. 3 and 4.

2.1 Usable Frequency Range

By changing the size of the fixed capacitor (tie-screw), the Model 2.040 and 2.041 can be used from 215 Mc to 265 Mc. The fixed capacitor is used to obtain the coarse frequency while the adjustable tuning capacitor is used for final tuning. This adjustable capacitor will tune the antenna over approximately 20 Mc from minimum to maximum capacitance. A graph of frequency vs tie-screw size is shown in Fig. 5.

2.2 Impedance and Bandwidth

The antenna is designed for a 100-ohm impedance since an array of two radiators is commonly used to give a usable radiation pattern. The impedance of a single antenna is shown in Fig. 6. The impedance of a parallel pair of antennas is shown in Fig. 7.

The bandwidth of a paralleled pair of antennas can be obtained from the impedance curve. The bandwidth is the difference between the extreme frequencies at which the impedance has a VSWR of less than 2:1. The bandwidth is 3 Mc within these limits. The bandwidth within a 1.5:1 VSWR is 1.8 Mc.

2.3 RF Breakdown

The rf breakdown was run with a CW signal and the average power was measured. Breakdown did not occur when the average power

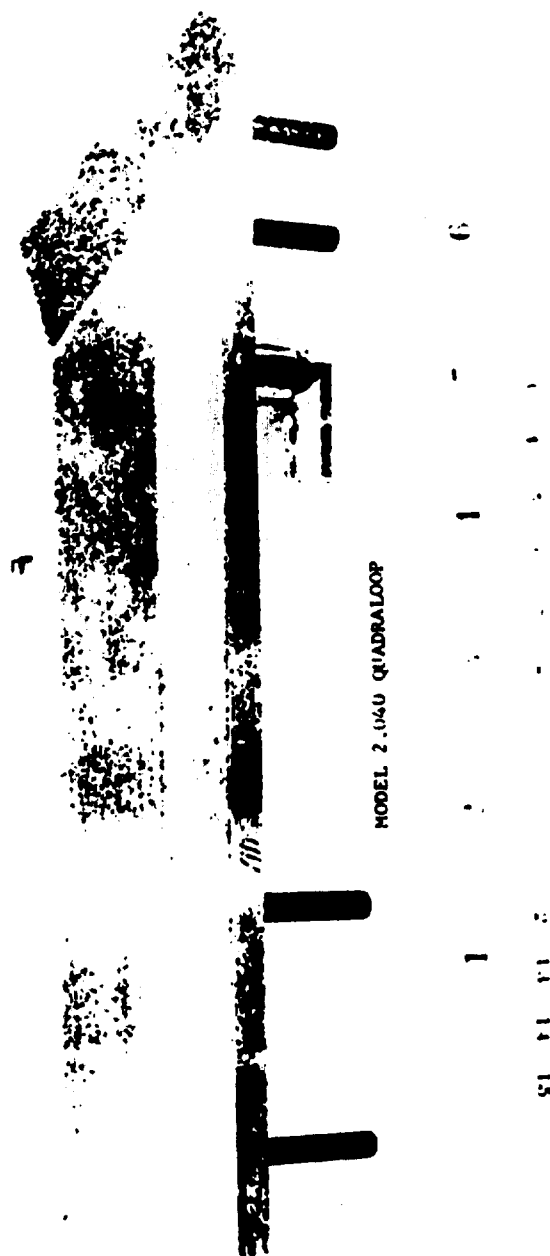


FIG. 1 - MODEL 2.040 QUADRALOOP

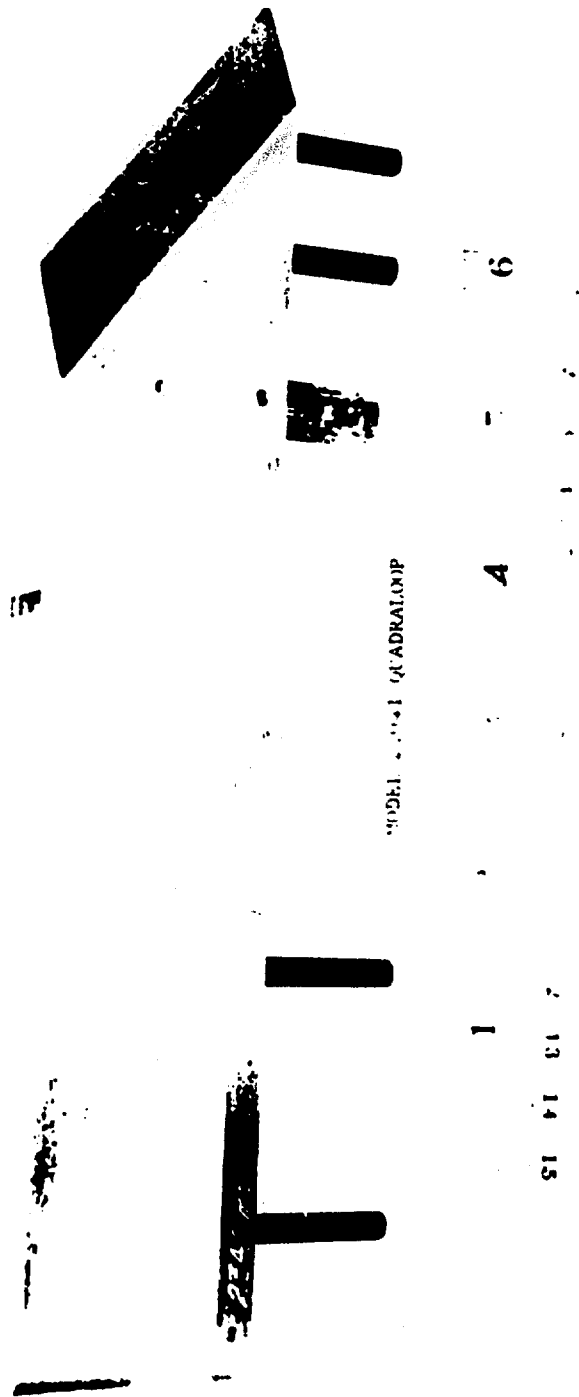
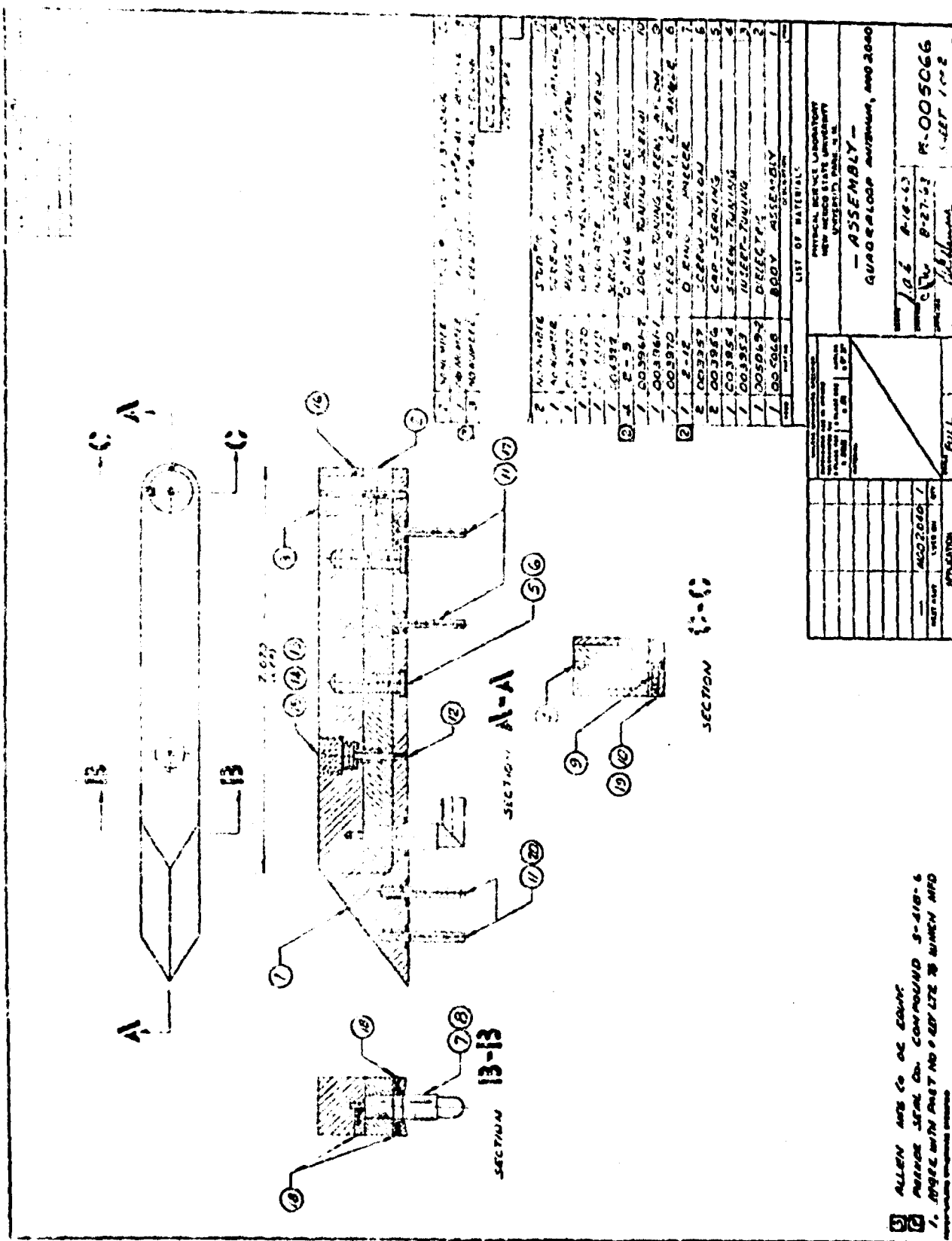
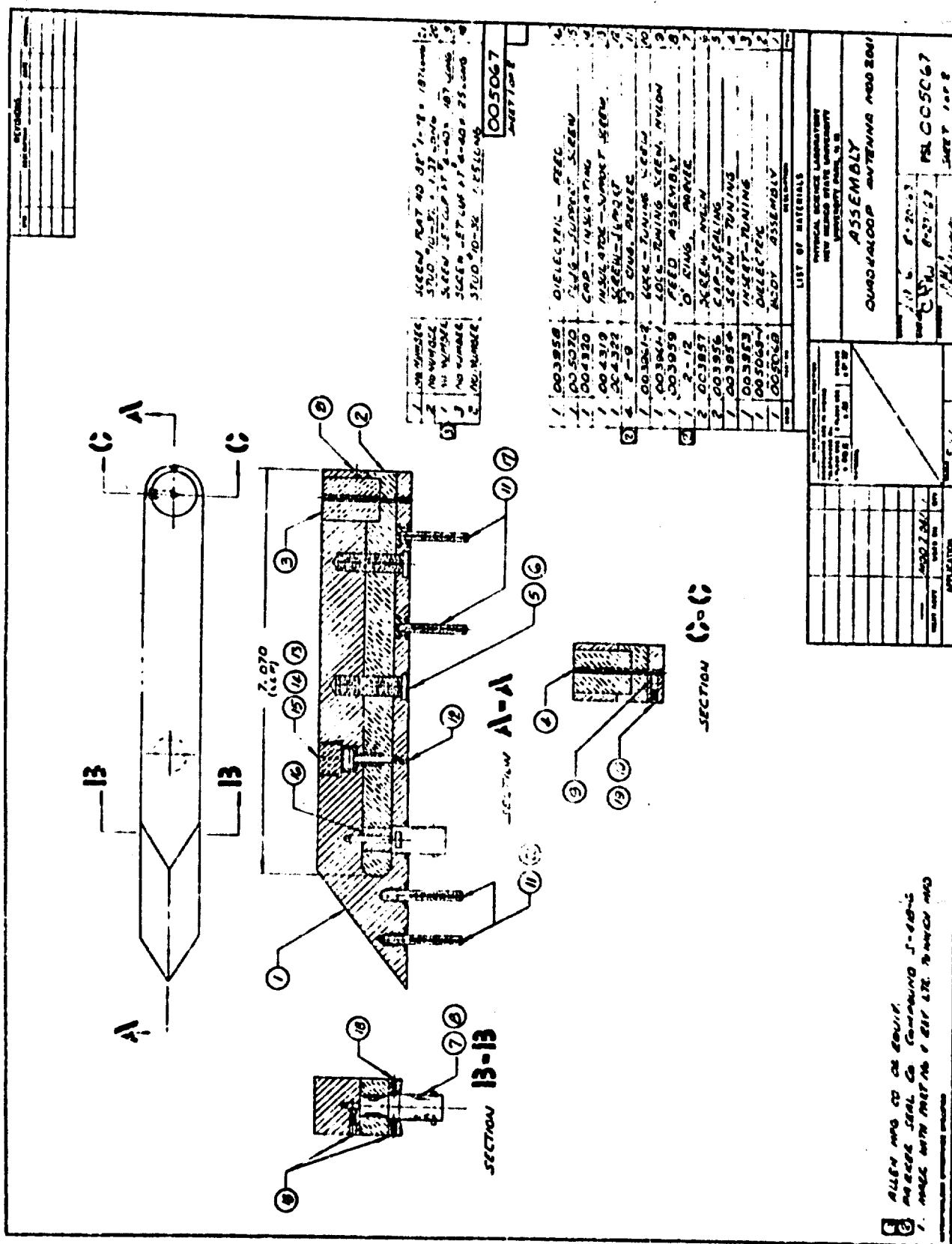


FIG. 2 - MODEL 2.041 QUADRALOOP





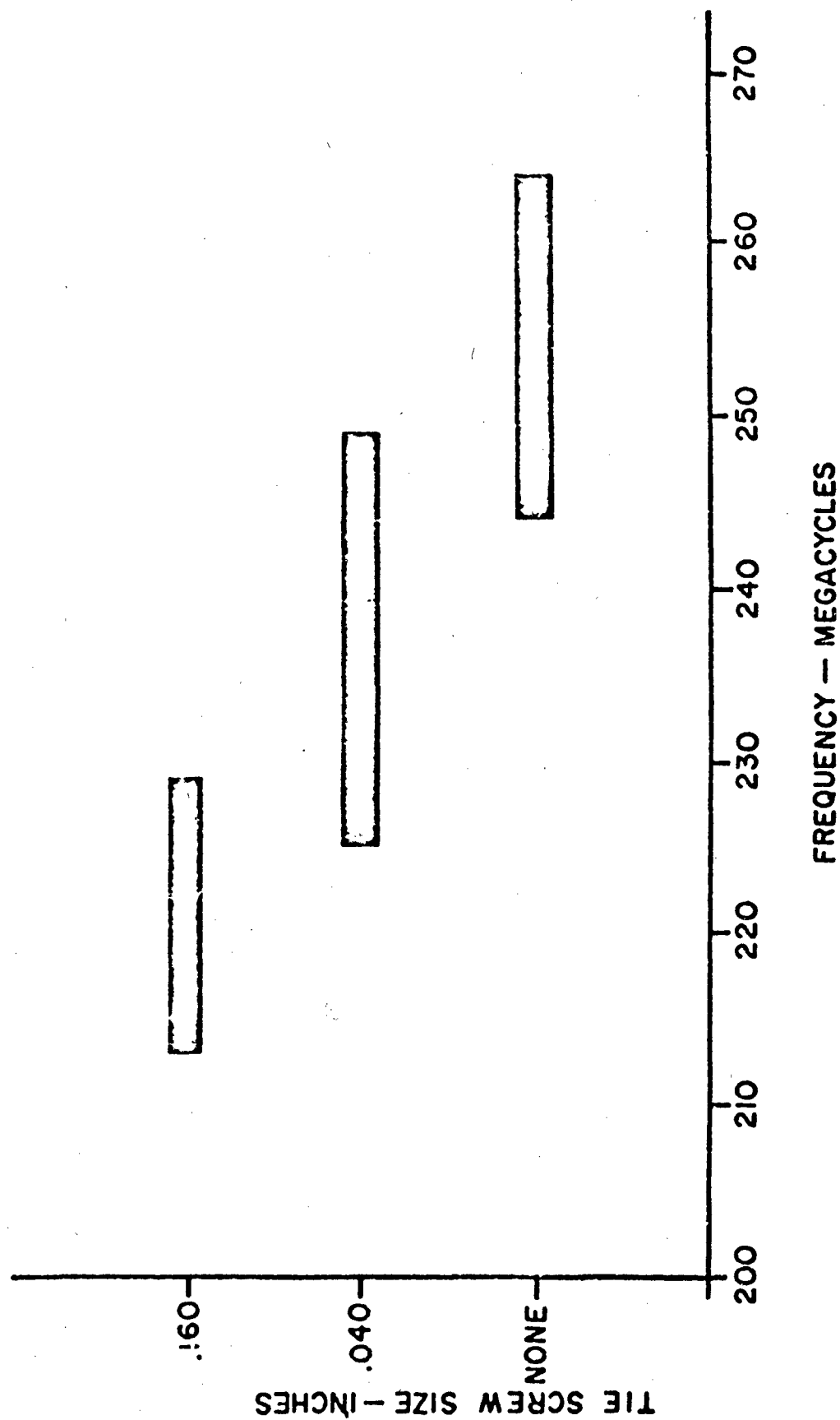


FIG. 5 - FREQUENCY RANGE VS TIE-SCREW SIZE

DATE _____

SWR 1.0 1.5 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 15.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0

dBS 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.5 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 12.0 15.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0

Reflection Coefficient Scales: Γ_{max} , Γ_{min} , Γ_{avg} , Γ_{rms} , Γ_{peak} , Γ_{val} , Γ_{eff} , Γ_{avg} , Γ_{rms} , Γ_{peak} , Γ_{val} , Γ_{eff}

Handwritten Calculation: $1.0 + j0.5 = 1.5 + j0.5$

NOMINALLY SCALED PARAMETERS

SWR 1.0 1.5 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 15.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0

dBS 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.5 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 12.0 15.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0

Reflection Coefficient Scales: Γ_{max} , Γ_{min} , Γ_{avg} , Γ_{rms} , Γ_{peak} , Γ_{val} , Γ_{eff} , Γ_{avg} , Γ_{rms} , Γ_{peak} , Γ_{val} , Γ_{eff}

GENERAL RADIO COMPANY

FIG. 6 - IMPEDANCE OF SINGLE QUADRAI (X)P

was 3 watts or below. The residual gas in the bell jar in which the breakdown was run was heavily ionized to more nearly approximate the actual flight conditions.

2.4 Radiation Characteristics

An array of two antennas is flown on the Aerobee rocket to give the best coverage. The antennas are fed 180° out of phase for this coverage. A power contour plot showing the radiated signal strength as seen by right circular polarization is shown in Fig. 8. The contours are plotted relative to a Stoddard half-wave dipole when illuminated by right circular polarization.

3.0 MECHANICAL CHARACTERISTICS

3.1 Construction

The antenna body of the Model 2.040 and 2.041 is made of aluminum. The tie-screw and the mounting studs are made of non-magnetic stainless steel. The leading edge of the antenna is shaped for a minimum of aerodynamic drag. All dielectric in the antenna is annealed Fluorosint.

3.2 Mounting

The antenna is mounted directly to the body of the missile by means of stainless steel studs in the base of the antenna. The feed point goes through the missile skin but is not attached to it. A mounting assembly is shown in Fig. 9. The mounting is the same for both Model 2.040 and 2.041. The dimension between the extreme mounting studs enables the antenna to be mounted on a 10-inch Aerobee extension without a plate or other similar device.

4.0 CONCLUSIONS

The Model 2.040 and 2.041 Quadraloop Antennas have all the advantages of the longer models without the additional length. These antennas can be used over the entire telemetry band. This means that a single mounting dimension can be used for all telemetry antennas whether on the Aerobee or any other missile. Thus these antennas will replace all previous quadraloop models for telemetry application.

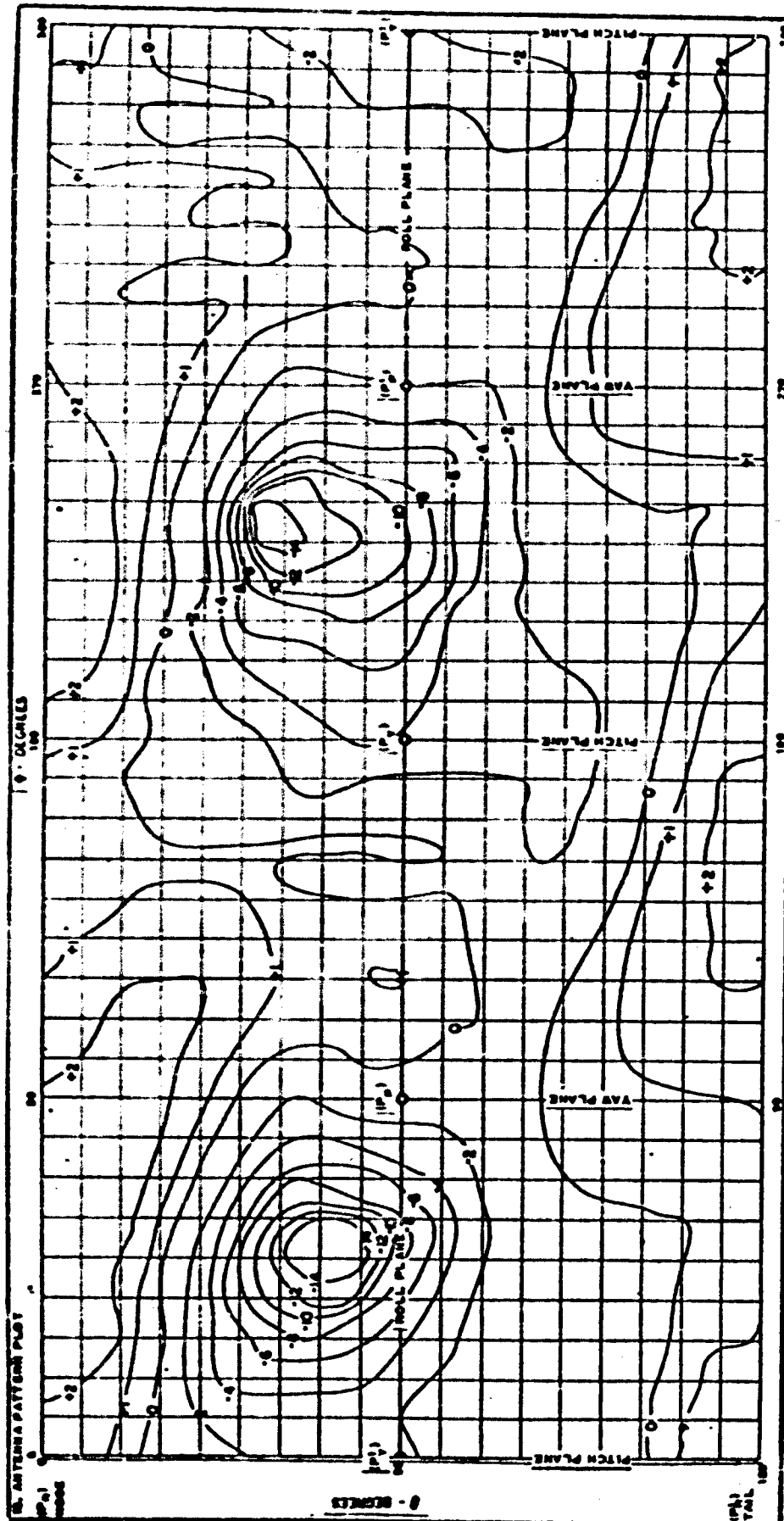
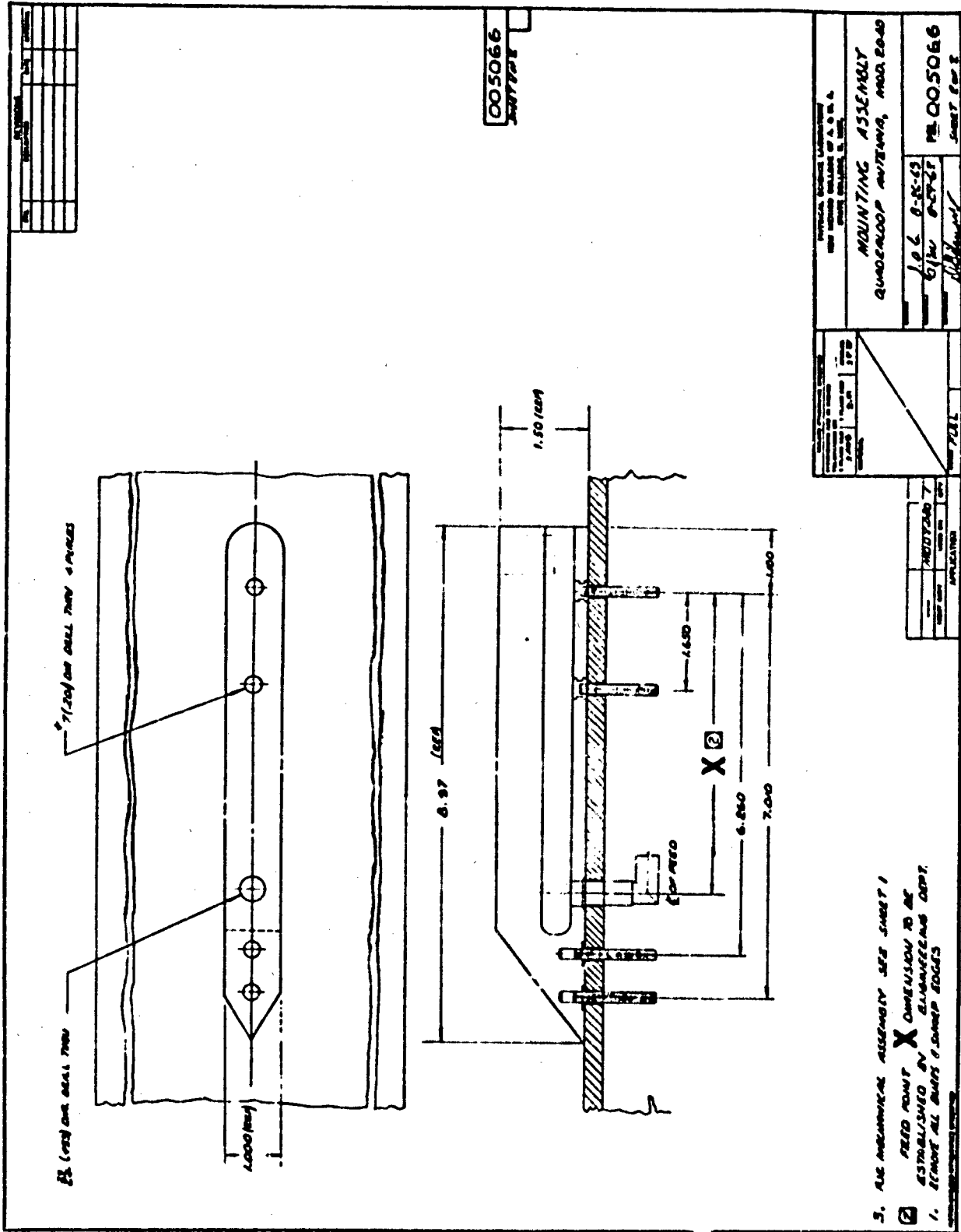


FIG. 8 - RADIATION POWER CONTOUR PLOT



**FIG. 9 - MOUNTING ASSEMBLY OF MODEL
2.040 AND 2.041 QUADRALOOPS**

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